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comparison is instituted between specimens from widely separated regions, or from strongly dissimilar hosts. This species of *Earlea* possesses an aecium exactly comparable in appearance and habit of growth with that of the species of *Phragmidium* under discussion; and in other ways a near relationship is evident.

The fixity of characters in *Earlea* and the high variability in *Phragmidium* as shown in American rose rusts present an interesting contrast. Regarding the latter it may be safely asserted that each species of *Phragmidium* has attained a degree of orthogenetic development and a diversity of characters corresponding to those of the hosts on which it occurs, always, however, with a certain lag due to the inhibiting nature of parasitism.

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THE PERENNATION OF THE CLOVER DODDER, *CUSCUTA EPITHYMUM* MURR *

BY F. C. STEWART AND G. T. FRENCH

In almost all botanical writings the numerous species of *Cuscuta* are all classed as annuals. It appears to be the prevailing opinion that none of the dodders survive the winter in the thread form and that, in order to perpetuate themselves, they must start anew every year from seeds. Yet, so long ago as 1868 Dr. Julius Kühn made the announcement,† based on his own observations, that clover dodder, *Cuscuta Trifolii* (= *C. Epithymum*), lives over winter on clover and alfalfa plants in Germany. Also, Sorauer, in the second edition of his well-known Handbuch der Pflanzenkrankheiten, published in 1886, states that clover dodder is not annual but perennial, and that on perennial plants it perpetuates itself more often by the further growth of the previous year's dodder plants than by the germination of new seeds. On the other hand, Frank,‡ ten years later, makes an equally positive statement that the dodders are all annual plants that start anew every year from seed. In 1900 Kühn

* Read before Section G of the American Association for the Advancement of Science, Baltimore Meeting, December 31, 1908.

† Ztschr. landw. Centralvereins der Provinz Sachsen 25 : 238.

‡ Die Krankheiten der Pflanzen, Zweite Aufl. 2 : 523.

published a second paper * on the subject, in which he characterizes the supposed annual habit of clover dodder as one of those errors which, even in the realm of science, are sometimes held to with remarkable tenacity. After citing his observations made in 1868, he states that he has since confirmed them in various years, even in those having the hardest winters.

With the exception of two recent articles † by the writers of this paper, there seems to be no published record of any dodder living over winter in the United States. Yet, our observations indicate that *Cuscuta Epithymum* is frequently perennial here. ‡ During the past three years this species has lived over winter in New York alfalfa fields, hibernating on the crowns of alfalfa, red clover, and certain weeds. This is not accidental or occasional, but of common occurrence. In the writers' opinion, it is the chief method by which dodder is carried over from one year to the next in New York alfalfa fields. In dodder-infested fields live dodder may be found readily during the winter and spring at any time when the ground is free from snow. One should take a sharp, heavy hoe or light grub-hoe and cut off and examine the crowns of plants standing on the margin of a dodder spot of the previous season. For the most part, the hibernating dodder threads appear in the form of tufts of short, stout yellow threads, one fourth to one half inch long, attached to the bases of the branches close down to the ground around the crown of the host plant and especially on the under sides of branches lying close to the ground. Yellow, haustoria-bearing threads tightly coiled around the very lowest parts of the stem are also common, but in no case have we observed dodder on the root proper.

Besides alfalfa and red clover, the favorite winter hosts of dodder are fleabane (*Erigeron annuus*) and yellow trefoil (*Medicago lupulina*). We have seen it also on dandelion. Although

* Ber. Physiol. Lab. u. Vers. Anst. Landw. Inst. Halle. 1900. Heft 14, 144-155.

† (1) Stewart, F. C. Further studies on alfalfa dodder and trefoil. N. Y. State Dept. Agr. Report of Director of Farmers' Institutes and Normal Institutes for the year 1906, 67, 1907. (2) Stewart, F. C. et. al. Troubles of alfalfa in New York. N. Y. Exp. Sta. Bull. 305. Nov., 1908.

‡ Full details of these observations are given in N. Y. Exp. Sta. Bul. 305: 369-374.

Erigeron annuus and *Medicago lupulina* are generally classed as annuals, they are regularly biennial in New York alfalfa fields.

While the appearance of the hibernating dodder is such that there seems little reason to doubt that it really is alive and capable of further growth, the writers have thought it best to place the matter beyond question by forcing the threads into growth. This has been accomplished several times by placing the dodder-infested crowns in a moist chamber for a few days. Given warmth and moisture the dodder threads begin to lengthen promptly. In six such experiments the dodder-infested crowns were placed in contact with thrifty young alfalfa plants growing in pots in a moist inoculation chamber in a greenhouse. In every case the dodder started promptly, established itself on the alfalfa plants and there made a vigorous growth.

Our observations have been confined to the State of New York; but dodder hibernates there so frequently and under such a variety of conditions as regards soil and exposure, that we can but believe that it is perennial also in other parts of the United States.

Whether other species besides *Cuscuta Epithymum* are perennial, we cannot now say. In every instance in which the identification of the dodder has been made possible by the appearance of flowers, the species has been found to be *C. Epithymum*.

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NOTES ON SAGITTARIA

BY KENNETH K. MACKENZIE

Almost all American botanists are acquainted with the common arrow-head (*Sagittaria latifolia* Willd.), and are familiar with the great amount of variation in the shape of its leaves. These are ordinarily strongly sagittate, but they vary from several inches broad to but two or three millimeters. All botanists are, however, thoroughly agreed that these variations, while striking, are of no importance from a systematic standpoint, but depend entirely on the conditions under which the plant has grown. This, then, being the thoroughly understood condition with reference